Form PTO-1390 (REV 11-98)	U.S DEPARTMENT OF COMMERCE PATENT AND TRADEMARK OFFICE	ATTORNEY'S DOCKET NUMBER 6900-14
TRANSMITTAL LETTER TO THE UNITED STATES DESIGNATED/ELECTED OFFICE (DO/EO/US) CONCERNING A FILING UNDER 35 U.S.C. 371		US APPLICATION NO (If known, see 37 CFR1 5) 10/088429
INTERNATIONAL APPLICATION NO. PCT/NL00/00659	INTERNATIONAL FILING DATE 18 September 2000	PRIORITY DATE CLAIMED 17 September 1999

TITLE OF INVENTION
METHOD OF SEPARATING PARTICLES IN A FLUID MEDIUM AND AN APPARATUS THEREFOR

APPLICANT(S) FOR DO/EO/US
REM, Peter Carlo, FRAUNHOLCZ, Norbert Otto, and DE BRUIJN, Arnoldus Johannes Matthijs.

Applicant herewith submits to the United States Designated/Elected Office (DO/EO/US) the following items and other information:

1. [X] This is a **FIRST** submission of items concerning a filing under 35 U.S.C. 371.

2. [ ] This is a **SECOND** or **SUBSEQUENT** submission of items concerning a filing under 35 U.S.C. 371.

3. [X] This express request to begin national examination procedures (35 U.S.C. 371(f)) at any time rather than delay examination until the expiration of the applicable time limit set in 35 U.S.C. 371(b) and PCT Articles 22 and 39(1).

4. [X] A proper Demand for International Preliminary Examination was made by the 19th month from the earliest claimed priority date.

5. [X] A copy of the International Application as filed (35 U.S.C. 371(c)(2))
   a. [X] is transmitted herewith (required only if not transmitted by the International Bureau).
   b. [ ] has been transmitted by the International Bureau.
   c. [ ] is not required, as the application was filed in the United States Receiving Office (RO/US)

6. [ ] A translation of the International Application into English (35 U.S.C. 371(c)(2))

7. [X] Amendments to the claims of the International Application under PCT Article 19 (35 U.S.C. 371(c)(3))
   a. [ ] are transmitted herewith (required only if not transmitted by the International Bureau).
   b. [ ] have been transmitted by the International Bureau.
   c. [ ] have not been made; however, the time limit for making such amendments has NOT expired.
   d. [x] have not been made and will not be made.

8. [ ] A translation of the amendments to the claims under PCT Article 19 (35 U.S.C. 371(c)(3)).

9. [X] An oath or declaration of the inventor(s) (35 U.S.C. 371(c)(4)). UNSIGNED

10. [X] A copy of the annexes to the International Preliminary Examination Report under PCT Article 36 (35 U.S.C. 371(c)(5)).

Items 11. to 16. below concern document(s) or information included:

11. [X] An Information Disclosure Statement under 37 CFR 1.97 and 1.98.

12. [ ] An assignment document for recording. A separate cover sheet in compliance with 37 CFR 3.28 and 3.31 is included.

13. [X] A FIRST preliminary amendment.
    [ ] A SECOND or SUBSEQUENT preliminary amendment.

14. [ ] A substitute specification.

15. [ ] A change of power of attorney and/or address letter.

16. [X] Other items or information: 2 Return receipt postcards

EXPRESS MAIL LABEL NO. EL 649720327 US

U.S. APPLICATION NO. (if known, see 37 CFR 1.5)	INTERNATIONAL APPLICATION NO	ATTORNEY'S DOCKET NUMBER
10/088429	PCT/NL00/00659	6900-14

17. [X] The following fees are submitted:

BASIC NATIONAL FEE (37 CFR 1.492(a)(1)-(5)):

Neither international preliminary examination fee (37 CFR 1.482) nor international search fee (37 CFR 1.445(a)(2)) paid to USPTO and International Search Report not prepared by the EPO or JPO.....**$1040.00**

International preliminary examination fee (37 CFR 1.482) not paid to USPTO but International Search Report prepared by the EPO or JPO..... **$890.00**

International preliminary examination fee (37 CFR 1.482) not paid to USPTO but international search fee (37 CFR 1.445(a)(2)) paid to USPTO..... **$740.00**

International preliminary examination fee paid to USPTO (37 CFR 1.482) but all claims did not satisfy provisions of PCT Article 33(1)-(4) **$710.00**

International preliminary examination fee paid to USPTO (37 CFR 1.482) and all claims satisfied provisions of PCT Article 33(1)-(4) **$100.00**

	CALCULATIONS PTO USE ONLY	
ENTER APPROPRIATE BASIC FEE AMOUNT =	$890.00	
Surcharge of **$130.00** for furnishing the oath or declaration later than[ ] 20 [ ] 30 months from the earliest claimed priority date (37 CFR 1.492(e)).		

CLAIMS	NUMBER FILED	NUMBER EXTRA	RATE		
Total claims	20-20 =	0	X $18.00	$ 0.00	
Independent claims	4-3 =	1	X $84.00	$ 84.00	
MULTIPLE DEPENDENT CLAIM(S) (if applicable)			$280.00	$ 0.00	
TOTAL OF ABOVE CALCULATIONS =				$974.00	
Reduction by 1/2 for filing by small entity, if applicable. A Small Entity Statement must also be filed (Note 37 CFR 1.9, 1.27, 1.28).				-$0.00	
SUBTOTAL =				**$974.00**	
Processing fee of **$130.00** for furnishing the English translation later than [ ] 20 [ ] 30 months from the earliest claimed priority date (37 CFR 1.429(f)).				$	
TOTAL NATIONAL FEE =				$974.00	
Fee for recording the enclosed assignment (37 CFR 1.21(h)). The assignment must be accompanied by an appropriate cover sheet (37 CFR 3.28, 3.31). **$40.00** per property +				$ 0.00	
TOTAL FEES ENCLOSED =				$974.00	
				Amount to be refunded:	
				Charged	$

a. [X] A check in the amount of $ 974.00 to cover the above fees is enclosed.

b. [ ] Please charge my Deposit Account No. 50-0951 in the amount of $ .00 to cover the above fees. A duplicate copy of this sheet is enclosed.

c. [X] The Commissioner is hereby authorized to charge any additional fees which may be required, or credit any overpayment to Deposit Account No. 50-0951. A duplicate copy of this sheet is enclosed.

NOTE: Where an appropriate time limit under 37 CFR 1.494 or 1.495 has not been met, a petition to revive (37 CFR 1.137(a) or (b)) must be filed and granted to restore the application to pending status.

SEND ALL CORRESPONDENCE TO:

J. Rodman Steele, Jr.
Akerman, Senterfitt & Eidson, P.A.
Post Office Box 3188
West Palm Beach, FL 33402-3188

SIGNATURE

J. Rodman Steele, Jr.
NAME

25,931
REGISTRATION NUMBER

PATENT

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Application of: REM et al.

Application No. Examiner:

Filed: (Herewith) Group Art Unit:

International Application No. PCT/NL00/00659

For: METHOD OF SEPARATING PARTICLES IN A FLUID MEDIUM AND AN APPARATUS THEREFOR

PRELIMINARY AMENDMENT

Box Patent Applications
Commissioner for Patents
Washington, D.C. 20231

Sir:

Prior to examination on the merits, please amend the above-identified application as follows:

IN THE CLAIMS:

4. (Amended) Method according to claim 1, characterized in that the fluid medium is an aqueous medium.

6. (Amended) Method according to claim 4, characterized in that the aqueous medium has a temperature of about 0°C.

7. (Amended) Method according to claim 1, characterized in that separate discharge-facilitating particles are present in the fluid medium.

9. (Amended) Method according to claim 1, characterized in that the barrier for restraining the particles is an element provided in the separation chamber.

10. (Amended) Method according to claim 1, characterized in that the element for restraining the particles comprises passages for the passage of the fluid medium.

11. (Amended) Method according to claim 1, characterized in that the element is provided at an angle with the horizontal, preferably at an angle between 2 - 45°, more preferably between 5 - 30° such that the particles are transported

REMARKS

The foregoing Preliminary Amendment is made to present alternative definitions of the invention. No new matter is added. Examination on the merits is respectfully requested.

Respectfully submitted,

Date: 3/15/02

J. Rodman Steele, Jr.
Registration No. 25,931
Akerman, Senterfitt & Eidson, P.A.
222 Lakeview Avenue, 4th Floor
Post Office Box 3188
West Palm Beach, FL 33402-3188
Telephone: (561) 653-5000

Docket No. 6900-14

PATENT

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Application of: REM et al.

Application No. Examiner:

Filed: (Herewith) Group Art Unit:

International Application No. PCT/NL00/00659

For: METHOD OF SEPARATING PARTICLES IN A FLUID MEDIUM AND AN APPARATUS THEREFOR

ATTACHMENT TO PRELIMINARY AMENDMENT SHOWING MODIFICATIONS

Box Patent Applications
Commissioner for Patents
Washington, D.C. 20231

Sir:

In accordance with 37 CFR §1.121, the amendments made to the application are as follows:

IN THE CLAIMS:

4. (Amended) Method according to [any of the preceding claims] claim 1, characterized in that the fluid medium is an aqueous medium.

6. (Amended) Method according to claim 4 [or 5], characterized in that the aqueous medium has a temperature of about 0°C.

7. (Amended) Method according to [any of the preceding claims] claim 1, characterized in that separate discharge-facilitating particles are present in the fluid medium.

9. (Amended) Method according to [any of the preceding claims] claim 1, characterized in that the barrier for restraining the particles is an element provided in

the separation chamber.

10. (Amended) Method according to [any of the preceding claims] claim 1, characterized in that the element for restraining the particles comprises passages for the passage of the fluid medium.

11. (Amended) Method according to [any of the preceding claims] claim 1, characterized in that the element is provided at an angle with the horizontal, preferably at an angle between 2 - 45°, more preferably between 5 - 30° such that the particles are transported

Respectfully submitted,

Date: 3/15/02

J. Rodman Steele, Jr.
Registration No. 25,931
Akerman, Senterfitt & Eidson, P.A.
222 Lakeview Avenue, 4th Floor
Post Office Box 3188
West Palm Beach, FL 33402-3188
Telephone: (561) 653-5000

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(71) Applicant *(for all designated States except US)*: **TECHNISCHE UNIVERSITEIT DELFT** [NL/NL]; Julianalaan 134, NL-2628 BL Delft (NL).

(72) Inventors; and

(75) Inventors/Applicants *(for US only)*: **REM, Peter, Carlo** [NL/NL]; Jaagpad 5B, NL-2288 AB Rijswijk (NL). **FRAUNHOLCZ, Norbert, Otto** [HU/NL]; Tichelberg 6, NL-2716 LL Zoetermeer (NL). **DE BRUIJN, Arnoldus, Johannes, Matthijs** [NL/NL]; Papenstraat 81, NL-2611 JB Delft (NL).

(74) Agent: **ALTENBURG, Bernardus, Stephanus, Franciscus**; Octrooibureau Los En Stigter B.V., Weteringschans 96, NL-1017 XS Amsterdam (NL).

(81) Designated States *(national)*: AE, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, CA, CH, CN, CR, CU, CZ, DE, DK, DM, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, TZ, UA, UG, US, UZ, VN, YU, ZA, ZW.

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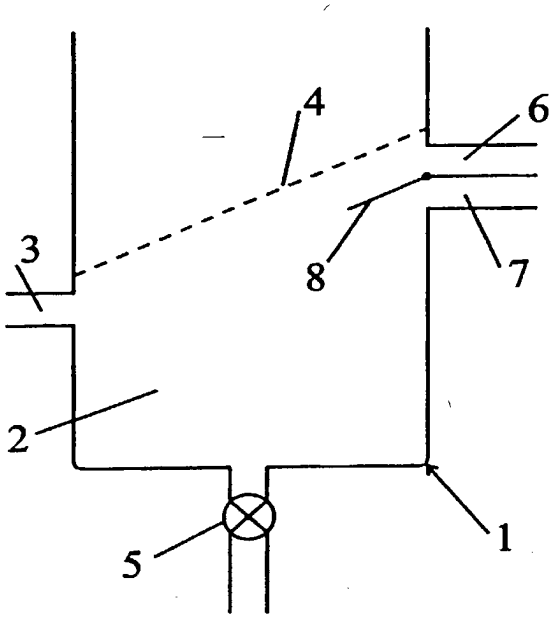
(54) Title: METHOD OF SEPARATING PARTICLES IN A FLUID MEDIUM AND AN APPARATUS THEREFOR



(57) Abstract: The invention relates to a method of separating particles in a fluid medium, wherein the particles have a density lower than that of the fluid medium. According to the invention the particles are subjected to an up and down moving flow of the fluid medium, whereby a barrier is present above the particles restraining said particles. It appears that with the method according to the invention a particle separation can be performed in a cost effective and quick manner. The invention is in particular suited for the separation of plastics, such as polyethylene and polypropylene. The invention also relates to an apparatus suitable for performing the method.

WO 01/21317 A1

Method of separating particles in a fluid medium and an apparatus therefor

The present invention relates to a method of separating particles in a fluid medium having a density higher than that of the particles to be separated, whereby a mixture of the particles to be separated is fed to a separation chamber of a separation apparatus, and streams enriched in a particular type of particles are discharged from the separation chamber.

The use of a fluid medium for the separation of a mixture of particles in two or more fractions is generally known. When the particles have a specific density lower than that of the fluid medium, such a separation is not very easy. It is known in the art to use centrifugation in order to increase the effect of the difference in density between the types of particles. This technique is expensive and often results in an unsatisfactory separation.

The object of the present invention is to provide a method wherein mixtures comprising different types of particles can be separated adequately.

To this end, the method according to the present invention is characterized in that the mixture of particles is subjected to a treatment comprising the step of moving the fluid medium up and down relative to the mixture of particles, whereby a barrier is present above the particles for restraining the particles.

Surprisingly it has been found that moving a mixture of particles having a density lower than that of the fluid medium up and down relative to said fluid medium (also known as "jigging") may effect stratification to achieve a separation. Jigging has been known for decades but not for the separation of particles having a density lower than that of the surrounding fluid medium. The mixture may comprise, for example, cork or wood. It may also be a mixture derived from domestic refuse. The barrier present for restraining the particles may be the face of the fluid medium. A stream enriched in particles of a particular type comprise the fluid medium

and the particular particles. The separation according to the present invention will result in (at least) two streams: A first stream enriched in first particles having a density lower than that of the fluid, and a second stream enriched in second particles having a density lower than that of the fluid.

According to an important embodiment, the particles to be separated are plastic particles.

The separation of plastics is a very important application for which, indeed, currently a number of different techniques is available, but which all suffer from one or more important disadvantages. For example, it is known to separate particles electrostatically, (which method is very sensitive to the presence of humidity), measuring particles individually using infrared light, (which method is slow and expensive), performing a float-sink separation in a hydrocyclone or using water-air suspensions. The separation of plastics makes it possible to obtain higher grade plastics which can be used for the manufacture of new plastic products. In addition, the use of compatibilizers is substantially avoided or even unnecessary. This not only entails a savings in cost, but also the plastic product manufactured from the recycled material is of higher quality, and can be re-used more often.

According to an important embodiment, the plastic particles are polyolefines.

Using the method according to the present invention, a separation may be performed quickly and efficiently even with very similar plastics, such as polyethylene and polypropylene.

According to an important embodiment, the fluid medium is an aqueous medium, in particular water.

The use of aqueous media and in particular water, which are very cheap fluid media, does not result in contamination of the streams enriched in a particular type of particles and do not discharge volatile organic compounds (or just to a reduced extent). When using an aqueous medium such as water for the separation of plastics, care should be taken that the particles are well wetted by the fluid medium in or-

der to prevent adherence of air bubbles (which cause a false change in the density of the particle). This may be accomplished using friction-washing with the fluid medium or by adding low concentrations of surfactants. It is also possible to perform the method under elevated pressure (as a result of which any air bubbles present dissolve), or under reduced pressure (resulting in larger air bubbles which can more easily escape, after which the method is preferably again performed at ambient pressure).

According to an important embodiment, the aqueous medium has a temperature of about 0°C.

At this temperature the ratio of the densities of plastics to be separated, such as polyethylene and polypropylene, is maximal.

According to an important embodiment, separate discharge-facilitating particles are present in the fluid medium.

The presence of facilitating particles may be of particular importance when the composition of the mixture varies. By placing a partition substantially in the middle of the layer of the facilitating particles, the achievement of an optimal separation may be ensured. The facilitating particles may be separated from a stream enriched with a particular type of particles by any suitable means, such as the use of magnetism if the facilitating particles are ferromagnetic. Of course, facilitating particles recovered will be fed back into the separation chamber.

In this manner the separation of two types of particles may be optimised. It is also conceivable that more layers of facilitating particles are formed between (for example three) different types of particles.

Preferably the facilitating particles are bulky particles having a density between the densities of the streams enriched in particular particles.

This embodiment is very advantageous when the particles to be separated are flakes. The bulky particles will experience an effective density of its surrounding determined by both the density of the fluid medium and the particles

present. The different shape of the particles to be separated on the one hand and the facilitating particles on the other, makes it very easy to separate the facilitating particles from a stream enriched in a particular type of particle. The bulky facilitating particles may have a largest size similar to that of the largest particles to be separated, but its thickness will be significantly more than that of the particles to be separated, such as at least five times more. Advantageously the bulky particles are, for example, approximately spherical particles, cylindrical particles or polygonal bodies such as cubes etc.

Preferably an element provided in the separation chamber is used as the barrier for restraining the particles in the separation chamber.

Such an element makes it easy to generate the up and down moving flow of fluid medium while causing a minimal disturbance of particle layers already partially separated.

Preferably the element for restraining the particles comprises passages for the passage of the fluid medium.

As such an element a sieve or grating is suitable, the openings of which will suitably, be smaller than the smallest particles of the mixture.

Preferably the element is at an angle with the horizontal, preferably at an angle between 2-45°, and more preferably between 5-30°, 5-20° being most preferred, such that the particles are transported away from the supply opening. This aids in the transport of the particle layers in the separation chamber.

The invention also relates to a device suitable for separating particles having a density lower than that of the fluid medium.

Such an apparatus is characterized in that the apparatus comprises a separation chamber having a supply opening for particles to be separated and an element provided above the supply opening for restraining said particles, which apparatus is further provided with means for moving a fluid medium up and down relative to the particles to be separated.

Using such an apparatus makes it possible to achieve

an efficient separation of the particles in a cheap and simple manner. The element and the means for moving the fluid medium up and down may be the same, that is a sieve (or screen).

Preferably the element comprises openings for the passage of a fluid medium.

Such an element may suitably be a sieve of grating, of which the openings will suitably, be smaller than the smallest particles of the mixture.

According to a preferred embodiment, the element is provided at an angle with the horizontal, preferably at an angle between 2-45°, more preferably between 5-30°, 5-20° being most preferred, such that the particles are transported away from the place where they are supplied.

The invention also relates to an apparatus suitable for separating particles having a density lower than that of a fluid medium.

This apparatus is characterized in that the apparatus comprises a separation chamber having a supply opening for the particles to be separated said supply opening extending in a substantially radial direction and an element is provided above the supply opening, said element comprising a multitude of openings allowing the passage of said particles, first means are provided to move the fluid medium up and down relative to the particles to be separated and second means are provided to rotate the element relative to fluid medium in the separation chamber.

In operation, the mixture of particles to be separated will be supplied below facilitating particles. The element and the fluid medium may be rotated at the same speed (and in the same direction), allowing a very simple separation operation. The particles with higher density which do not pass the barrier consisting of the facilitating particles may be removed from the separation chamber, for example together with the facilitating particles. The facilitating particles can be separated from the particles with higher density by any conventional method, such as separation by size, using magnetic fields etc.

According to an interesting embodiment, the apparatus comprises means for locally disturbing a mass comprising added particles not capable of passing through the openings of said element and particular particles separated from particles which have passed through said openings of said element.

Thus it is possible to use the element to separate the facilitating particles from the particles having higher density. The means may comprise a pipe provided with a slit or number of nozzles from which fluid medium is ejected.

The invention also relates to a specific method of separating particles in a fluid medium having a density higher than that of the particles to be separated, wherein an apparatus according to the invention is used, a mixture of particles to be separated is supplied below a layer of facilitating particles having a thickness which doesn't allow them to pass through the openings of the element, the fluid medium in the separation chamber is rotated relative to the element, the element is moved up and down to move the fluid medium relative to the particles to be separated, causing particles with lower density to pass through the facilitating particles and through the openings in said element to end up in fluid medium above said element from which the particles are discharged from the separation chamber, whereas the facilitating particles act as a barrier for and restrain the particles with higher density, which particles with higher density are discharged from the separation chamber in the fluid medium below said element.

Preferably, the fluid medium is rotated with respect to the wall of the separation chamber.

According to an alternative method of separating particles in a fluid medium having a density higher than that of the particles to be separated, an apparatus according to an alternative embodiment of the invention is used, a mixture of particles to be separated is supplied below a layer of facilitating particles having a thickness which doesn't allow them to pass through the openings of the element, the fluid medium in the separation chamber is rotated relative to the

element, the element is moved up and down to move the fluid medium relative to the particles to be separated, causing particles with lower density to pass through the facilitating particles and through the openings in said element to end up in a first section comprising fluid medium above said element from which first section the particles are discharged from the separation chamber, whereas the facilitating particles act as a barrier for and restrain the particles with higher density, the means for locally disturbing the mass of facilitating particles and restrained particles with higher density, allowing said particles with higher density to pass through the openings in said element to end up in a second section above the element separated from the first section and discharging a stream enriched in particles having a higher density from the separation chamber.

The present invention will now be illustrated with reference to a drawing and an exemplary embodiment wherein

Fig. 1 depicts a schematic representation of an apparatus according to the invention;

Figs. 2a - d each show a picture of four successive points in time during the separation of particles using the method according to the invention;

Fig. 3 depicts a first alternative schematic representation of an apparatus according to the invention; and

Fig. 4 depicts a second alternative schematic representation of an apparatus according to the invention.

The apparatus 1 shown in Fig. 1 possesses a chamber 2 provided with a supply opening 3 through which a mixture of particles to be separated can be supplied. Above the supply opening 3 a sieve 4 is mounted, the lowest part of the sieve 4 being adjacent to the supply opening 3. In operation, a fluid medium is present in separation chamber 2, which fluid can be moved up and down using a pump 5. For the discharge of separated particles two discharge openings 6, 7 are provided as well as a partition 8 for separating the particle layers. This partition 8 is preferably rotatable, making it easier to subject a mixture in which the ratio of the type of particles varies, to a separation.

It has been found that it is advantageous to increase the resistance with which the fluid medium may flow though the passages of the sieve 4. This may be achieved, for example, by putting a layer of pebbles on top of the sieve 4.

If necessary, the mixture of particles to be separated is first subjected to a separation according to particle size, but the method according to the present invention is, in case of flake-shaped particles to be separated, surprisingly insensitive to the diversity of particle size in the mixture.

According to a very interesting embodiment particles to facilitate/separate discharge of different particles are present. According to a first embodiment, these particles will facilitate the division into separate streams of layers comprising a particular type of particle resulting from the separation. A partition can be placed in the layer of facilitating particles. This is much easier than determining the border between two layers comprising different particles. According to a second embodiment, the use of facilitating particles makes it possible to use a barrier having openings allowing the passage of the particles to be separated. For example and as schematically depicted in Fig. 3, the openings in sieve section 4a do not allow for the passage of particles. The screen section 4b allows for the passage of lower-density particles (which are discharged from the separation chamber 2 through outlet 13 shown in fig. 4), whereas higher-density particles, which are not capable of penetrating the layer of facilitating particles, will pass through openings in sieve section 4c and are discharged from the separation chamber 2 through outlet 14 (shown in fig. 4).

The apparatus shown in fig. 4 (top view) comprises a circular screen 4 (shown in part) which retains facilitating particles having density chosen such that they end up between particles having a relative low density and particles having a relative high density. The mixture of particles to be separated is supplied in a substantially radial direction through a supply tube 9 having a slit-like supply opening 3 or a multitude of supply openings 3 distributed over a substantial

part of the length of the supply tube 9. Both the screen 4 and the fluid medium in the separation chamber 2 are rotated counter-clockwise. This may be accomplished using a water jet. According to an alternative embodiment, the rotating screen 4 causes the fluid medium to rotate. To avoid a detrimental effect because of turbulence near the wall of the separation chamber, the screen 4 may be provided with circumferential, downward extending wall (not shown, but similar to fig. 3 near supply opening 3), the wall having a height larger than the length of stroke during operation.

In operation, particles having a lower density will pass through the layer of facilitating particles and through openings in the screen 4. A stream comprising fluid medium and particles having a lower density may be discharged from the separation chamber 2 from above the screen 4. The facilitating particles act as a barrier for the particles having a relatively higher density. The latter particles may be removed from below the screen 4 together with (a part of) the facilitating particles. Any facilitating particles present in a stream enriched in particles having a higher density may be separated using any conventional means, and will be fed back into the separation chamber 2 below the screen 4.

Alternatively, the screen 4 may be used to separate the denser particles from the facilitating particles by disturbing the strata (facilitating particles and denser particles). This may be easily achieved using pipes 12 provided with nozzles which supply fluid medium to disturb the subtle balance in the strata, causing the denser particles to go through the screen 4. In this case, two separate sections 10, 11 are provided above the screen 4. Both sections 10, 11 may move up and down together with the screen, but do not rotate. The first section 10 is used to collect particles having a lower density, the second section 11 is used to collect particles having a higher density.

Example 1

A mixture was prepared of 0.8 kg HDPE (white: density 945 kg/m^3) and 0.2 kg PP (blue, density 900 kg/m^3). The

grain size of both types of plastic was 1.7 - 4 mm. The apparatus used had a separation chamber with a volume of 3.1 litre and a diameter of 19 cm. Water was used as the fluid medium. To separate, the water was moved up during 1 second and down during 3 seconds in an asymmetric sinusoidal manner. The length of stroke was 9 cm. The stationary screen had passages of 0.5 mm square, with 100 passages per cm^2.

Fig. 2 shows that despite the small difference in density a separation can be achieved very quickly. The pictures a - d were taken within a timespan of 2 min.

Example 2

In this experiment, an apparatus as depicted in fig. 3 was used having a sieve 4 made of bars providing slit-like openings (width 6 mm, length several cm). Facilitating particles were used having a density of 970 kg/ m^3, a length of 8-12 mm, a diameter of 8 mm and in an amount equivalent to two layers, to separate flakes of PP (density approximately 900 kg/ m^3) and HDPE (density approximately 950 kg/m^3). Conditions: frequency 10/minute; length of stroke: 45 mm; screen section 4a 300 mm, screen section 4b 50 mm. Screen width: 200 mm. Separation occurs in a period of 1-2 minutes. The PE obtained was almost pure (less than 1% PP). PP still comprised about 10% PE, which is still a significant improvement over the original 50/50.

10/088429 NL000065
JC13 Rec'd PCT/PTO 15 MAR 2002
EPO - DG 1

10. 10. 2001

(52)

CLAIMS

1. Method of separating particles in a fluid medium having a density higher than that of the particles to be separated, whereby a mixture of the particles to be separated is fed to a separation chamber of a separation apparatus, and streams enriched in a particular type of particles are discharged from the separation chamber, **characterized** in that the mixture of particles is subjected to a treatment comprising the step of moving the fluid medium up and down relative to the mixture of particles, whereby a barrier is present above the particles for restraining the particles.

2. Method according to claim 1, **characterized** in that the particles to be separated are plastic particles.

3. Method according to claim 2, **characterized** in that the plastic particles to be separated are polyolefines.

4. Method according to any of the preceding claims, **characterized** in that the fluid medium is an aqueous medium.

5. Method according to claim 4, **characterized** in that the aqueous medium is water.

6. Method according to claim 4 or 5, **characterized** in that the aqueous medium has a temperature of about 0°C.

7. Method according to any of the preceding claims, **characterized** in that separate discharge-facilitating particles are present in the fluid medium.

8. Method according to claim 7, **characterized** in that facilitating particles are bulky particles having a density between the densities of the streams enriched in particular particles.

9. Method according to any of the preceding claims, **characterized** in that the barrier for restraining the particles is an element provided in the separation chamber.

10. Method according to any of the preceding claims, **characterized** in that the element for restraining the particles comprises passages for the passage of the fluid medium.

11. Method according to any of the preceding claims, **characterized** in that the element is provided at an angle

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with the horizontal, preferably at an angle between 2 - 45°, more preferably between 5 - 30° such that the particles are transported away from the place of supply.

12. Apparatus suitable for separating particles having a density lower than that of a fluid medium, wherein the apparatus comprises

- a separation chamber having a supply opening for particles to be separated;
- discharge openings for separated fractions of particles;
- an element possessing passages provided above the supply opening, the element defining a first portion of the separation chamber and a second portion of the separation chamber;
- means for moving a fluid medium up and down relative to the particles to be separated,

characterized in that the element is a particles restraining element, and supply opening and the discharge openings are in direct communication with each other via the first portion.

13. Apparatus according to claim 12, **characterized** in that the element is provided at an angle with the horizontal, preferably an angle between 2 - 45°, more preferable between 5 - 30.

14. Apparatus suitable for separating particles having a density lower than that of a fluid medium, wherein the apparatus comprises

- a separation chamber having a supply opening for particles to be separated;
- discharge openings for separated fractions of particles;
- an element possessing passages provided above the supply opening, the element defining a first portion of the separation chamber and a second portion of the separation chamber;
- means for moving a fluid medium up and down relative to the particles to be separated,

characterized in that the element has a first section with first passages and a second section with second passages, the first passages being smaller than the second passages, the first section being a particles restraining element, a supply

opening and a first discharge opening being in direct communication with each other via the first portion, the supply opening and a second discharge opening being in communication with each other via the first portion, the second section and the second portion.

15. Apparatus according to claim 14, **characterized** in that the element is provided at an angle with the horizontal, preferably an angle between 2 - 45°, more preferable between 5 - 30.

16. Apparatus suitable for separating particles having a density lower than that of a fluid medium the apparatus comprises

- a separation chamber having a supply opening for the particles to be separated;
- an element provided above the supply opening, said element comprising a multitude of openings allowing the passage of said particles; and
- means provided to move the fluid medium up and down relative to the particles to be separated,

characterized in that said supply opening extends in a substantially radial direction and second means are provided to rotate the element relative to fluid medium in the separation chamber.

17. Apparatus according to claim 16, **characterized** in that it comprises means for locally disturbing a mass comprising added particles not capable of passing through the openings of said element and particular particles separated from particles which have passed through said openings of said element.

18. Method of separating particles in a fluid medium having a density higher than that of the particles to be separated, **characterized** in that an apparatus according to claim 14 is used, a mixture of particles to be separated is supplied below a layer of particles having a thickness which doesn't allow them to pass through the openings of the element, the fluid medium in the separation chamber is rotated relative to the element, the element is moved up and down to move the fluid medium relative to the particles to be sepa-

rated, causing particles with lower density to pass through the facilitating particles and through the openings in said element to end up in fluid medium above said element from which the particles are discharged from the separation chamber, whereas the facilitating particles act as a barrier for and restrain the particles with higher density, which particles with higher density are discharged from the separation in the fluid medium below said element.

19. Method according to claim 18, **characterized** in that the fluid medium is rotated with respect to the wall of the separation chamber.

20. Method of separating particles in a fluid medium having a density higher than that of the particles to be separated, **characterized** in that an apparatus according to claim 16 is used, a mixture of particles to be separated is supplied below a layer of particles having a thickness which doesn't allow them to pass through the openings of the element, the fluid medium in the separation chamber is rotated relative to the element, the element is moved up and down to move the fluid medium relative to the particles to be separated, causing particles with lower density to pass through the facilitating particles and through the openings in said element to end up in a first section comprising fluid medium above said element from which first section the particles are discharged from the separation chamber, whereas the facilitating particles act as a barrier for and restrain the particles with higher density, the means for locally disturbing the mass of facilitating particles and restrained particles with higher density, allowing said particles with higher density to pass through the openings in said element to end up in a second section above the element separated from the first section and discharging a stream enriched in particles having a higher density from the separation chamber.

ABSTRACT OF THE DISCLOSURE

A method of separating particles in a fluid medium, wherein the particles have a density lower than that of the fluid medium. The fluid particles are subjected to an up and down moving flow of the fluid medium, whereby a barrier is present above the particles restraining said particles. It appears that a particle separation can be performed in a cost effective and quick manner. The method is in particular suited for the separation of plastics, such as polyethylene and polypropylene. An apparatus suitable for performing the method is also disclosed.

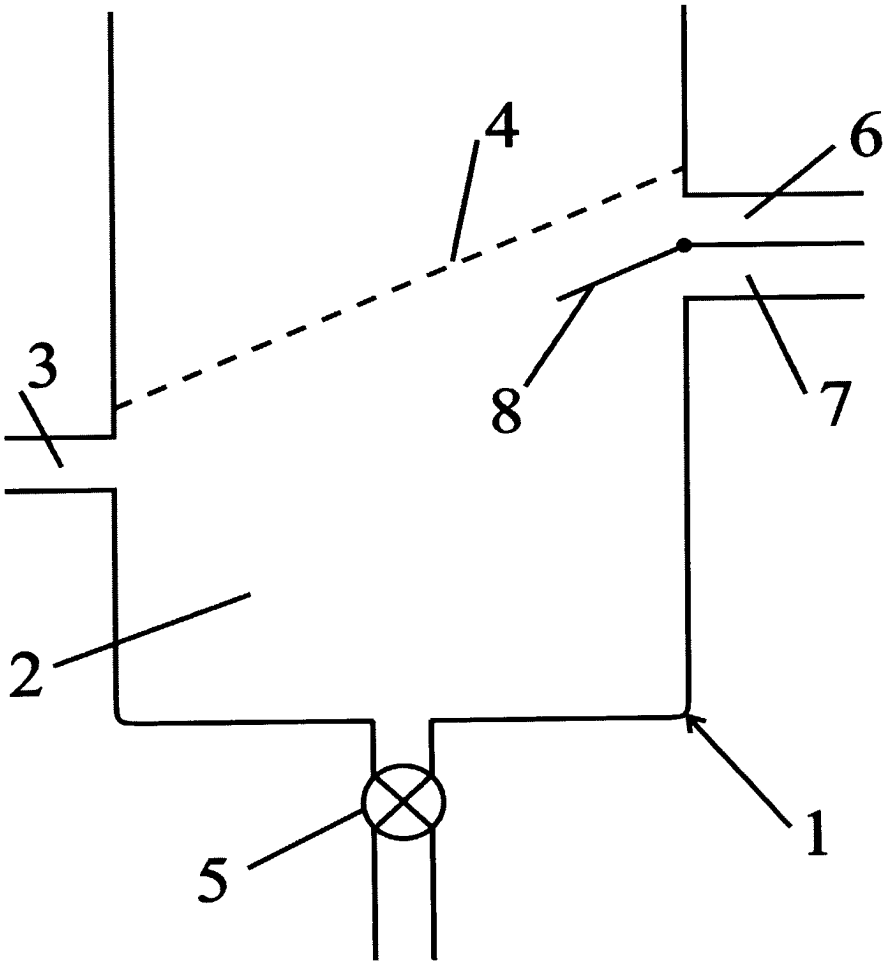


FIG.1

a b c d

Fig. 2

Fig. 3

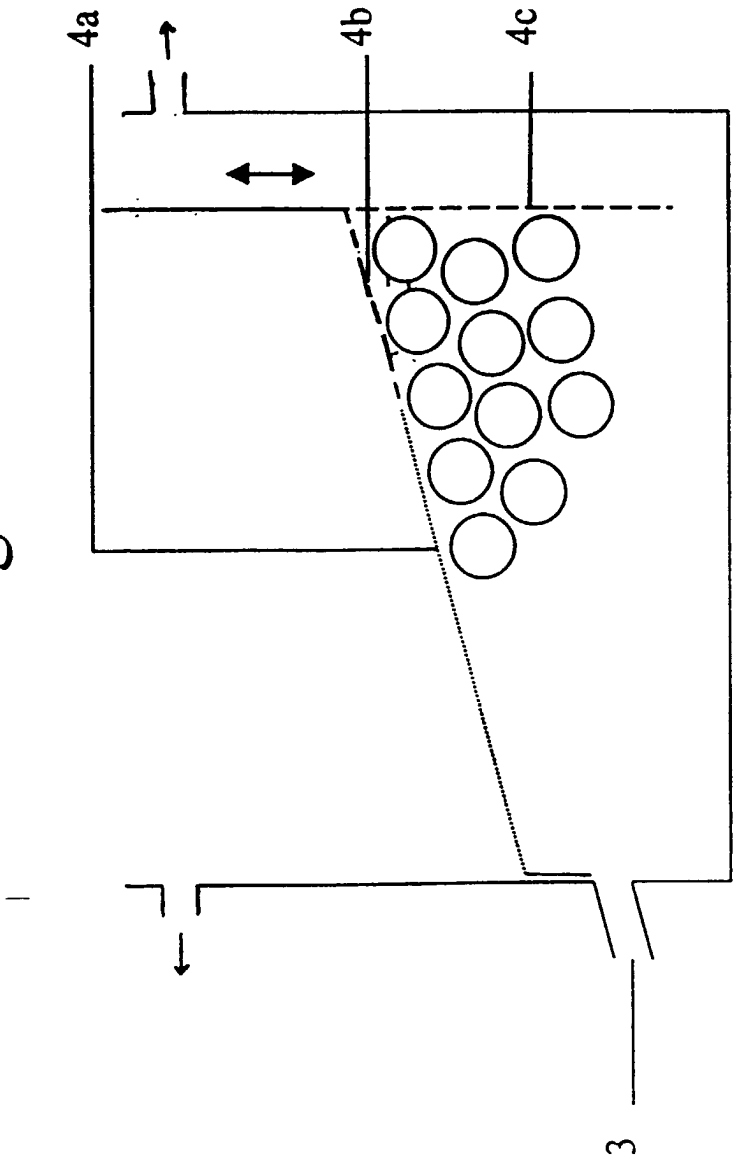
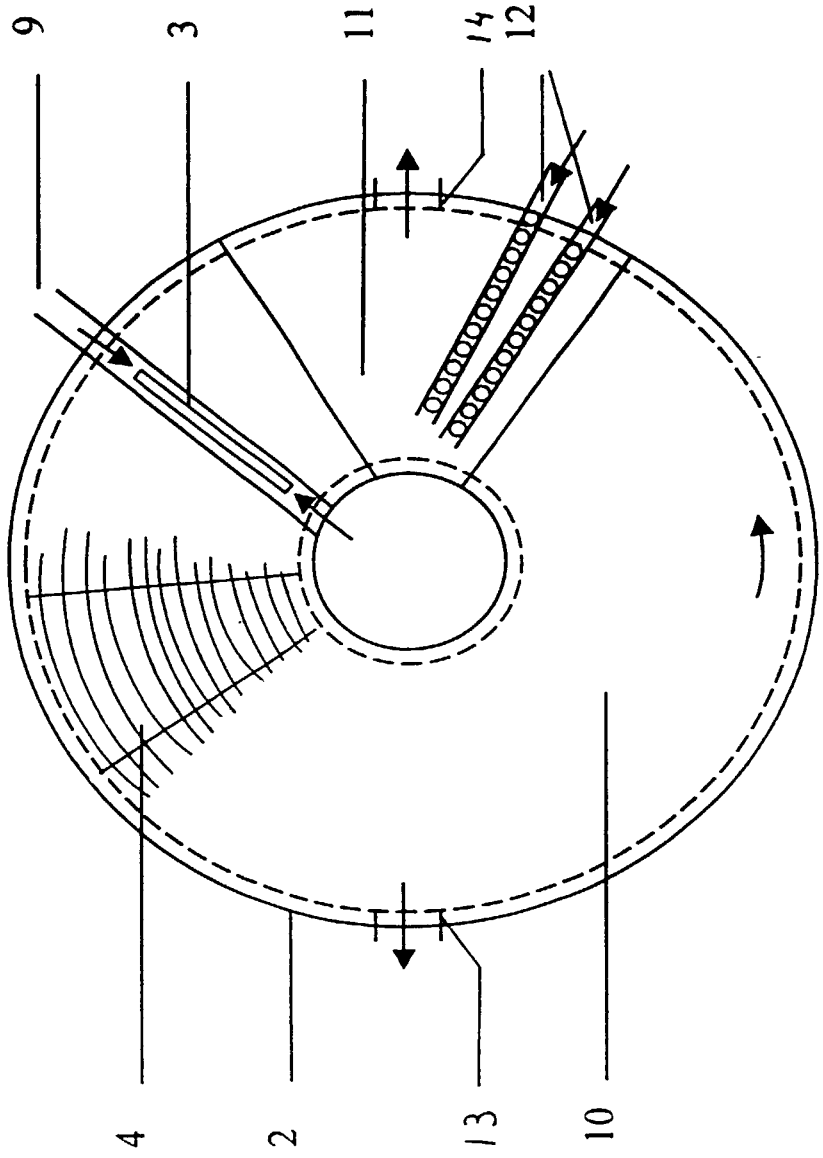


Fig. 4



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COMBINED DECLARATION FOR PATENT APPLICATION AND POWER OF ATTORNEY (Includes Reference to PCT International Applications)	ATTORNEY DOCKET NUMBER 6900-14

As a below named inventor, I hereby declare that:

My residence, post office address and citizenship are as stated below next to my name.

I believe that I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled:

METHOD OF SEPARATING PARTICLES IN A FLUID MEDIUM AND IN AN APPARATUS THEREFOR

the specification of which (check only one item below):

[] is attached hereto.

[] was filed as U.S. Patent Application Serial Number_____ on _____, as amended on _ (if applicable).

[x] was filed as a PCT international application number PCT/NL00/00659 on 18 September 2000, as amended under PCT Article 19 on ___ (if applicable).

I hereby state that I have reviewed and understand the contents of the above-identified specification, including the claims, as amended by any amendment referred to above.

I acknowledge the duty to disclose information which is material to the examination of this application in accordance with Title 37, Code of Federal Regulations §1.56(a).

I hereby claim foreign priority benefits under Title 35, United States Code, §119 of any foreign application(s) for patent or inventor's certificate or any PCT international application(s) designating at least one country other than the United States of America listed below and have also identified below any foreign application(s) for patent or inventor's certificate or any PCT international application(s) designating at least one country other than the United States of America filed by me on the same subject matter having a filing date before that of the applications for which priority is claimed:

PRIOR FOREIGN PATENT APPLICATION(S) AND ANY PRIORITY CLAIMED UNDER 35 U.S.C. §119:			
COUNTRY (If PCT indicate PCT)	APPLICATION NUMBER	DATE OF FILING (Day, Month, Year)	PRIORITY CLAIMED UNDER 35 USC 119
NETHERLANDS	1013087	17 September 1999	[x] YES [] NO
NETHERLANDS	1015168	12 May 2000	[x] YES [] NO
			[] YES [] NO
			[] YES [] NO
			[] YES [] NO

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I hereby claim the benefit under Title 35, United States Code, §120 of any United States application(s) or PCT international application(s) designating the United States of America that is/are listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in that/those prior application(s) in the manner provided by the first paragraph of Title 35, United States Code, §112, I acknowledge the duty to disclose material information as defined in Title 37, Code of Federal Regulations §1.56(a) which occurred between the filing date of the prior application(s) and the national or PCT international filing date of this application.

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U.S. APPLICATIONS		STATUS (Check One)		
U.S APPLICATION NUMBER	U.S. FILING DATE	PATENTED	ABANDONED	PENDING

PCT APPLICATIONS DESIGNATING THE U.S.					
PCT APPLICATION NUMBER	PCT FILING DATE	U.S. SERIAL NUMBERS			
PCT/NL00/00659	18 September 2000				

POWER OF ATTORNEY: As a named inventor, I hereby appoint the following attorneys and/or agents to prosecute this application and transact all business in the U.S. Patent and Trademark Office connected therewith: J. Rodman Steele, Jr., Registration No. 25,931; Gregory A. Nelson, Registration No. 30,577, Joseph W. Bain, Registration No. 34,290; Robert J. Sacco, Registration No. 35,667; Stanley A. Kim, Registration No. 42,730; Mark D. Passler, Registration No. 40,764; Steven M. Greenberg, Registration No. 44,725; Neil R. Jetter, Registration No. 46,803; Larry G. Brown, Registration No. 45,834; Kevin T. Cuenot, Registration No. 46,283; Raynaldo K. Whitty, Registration No. 47,176; Pablo Meles, Registration No. 33,739; Barbara S. Kitchell, Registration No. 33,928; Terry W. Forsythe, Registration No. 47,569; Mark M. Zylka, Registration No. 48,518; and Sarah E. Smith, Registration No. 50,488.

Send Correspondence to:	Direct Telephone Calls to: J. Rodman Steele, Jr.
Akerman, Senterfitt & Eidson, P.A. Post Office Box 3188 West Palm Beach, FL 33402-3188	(561) 653-5000

201	FULL NAME OF INVENTOR	FAMILY NAME: REM	FIRST GIVEN NAME: PETER	SECOND GIVEN NAME: CARLO
	RESIDENCE & CITIZENSHIP	CITY: RIJSWIJK	STATE OR COUNTRY: NETHERLANDS NLX	COUNTRY OF CITIZENSHIP: NETHERLANDS
	POST OFFICE ADDRESS	POST OFFICE ADDRESS: JAAGPAD 5B NL-2288 AB	CITY: RIJSWIJK	STATE & ZIP CODE/COUNTRY: NETHERLANDS
202	FULL NAME OF INVENTOR	FAMILY NAME: FRAUNHOLCZ	FIRST GIVEN NAME: NORBERT	SECOND GIVEN NAME: OTTO
	RESIDENCE & CITIZENSHIP	CITY: ZOETERMEER	STATE OR COUNTRY: NETHERLANDS NLX	COUNTRY OF CITIZENSHIP: HUNGARY
	POST OFFICE ADDRESS	POST OFFICE ADDRESS: TICHELBERG 6, NL-2716 LL	CITY: ZOETERMEER	STATE & ZIP CODE/COUNTRY: NETHERLANDS
203	FULL NAME OF INVENTOR	FAMILY NAME: DE BRUIJN	FIRST GIVEN NAME: ARNOLDUS	SECOND GIVEN NAME: JOHANNES
	RESIDENCE & CITIZENSHIP	CITY: DELFT	STATE OR COUNTRY: NETHERLANDS NLX	COUNTRY OF CITIZENSHIP: NETHERLANDS
	POST OFFICE ADDRESS	POST OFFICE ADDRESS: PAPENSTRAAT 81, NL-2611 JB	CITY: DELFT	STATE & ZIP CODE/COUNTRY: NETHERLANDS

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issuing thereon.

SIGNATURE OF INVENTOR 201	SIGNATURE OF INVENTOR 202	SIGNATURE OF INVENTOR 203
Peter	Frank	
DATE: March 6, 2002	DATE: March 6, 2002	DATE: March 6, 2002

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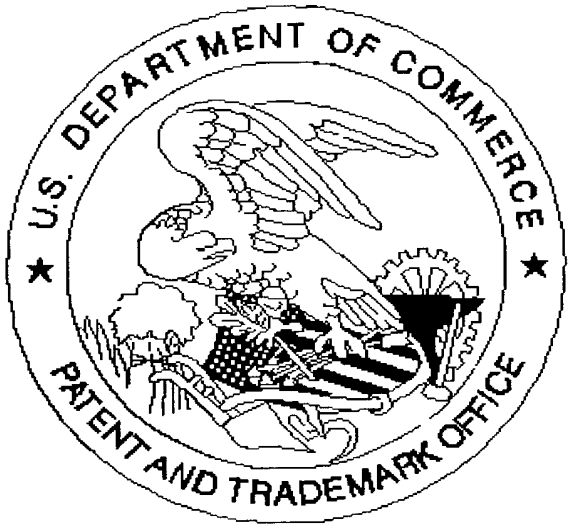

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